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THE SOUTH'S POSITION IN THE MINERAL INDUSTRY[1]

By Dr. R. S. POOR

PROFESSOR OF GEOLOGY, BIRMINGHAM-SOUTHERN COLLEGE, BIRMINGHAM, ALABAMA

THE mineral industry has been ranked equal in financial importance to transportation, being exceeded only by agricultural pursuits. The world average for the five years preceding 1931 was $12,000,000,000 worth of minerals annually. In 1931 the figure dropped to $8,000,000,000.

In the United States the average annual mineral production has averaged $5,500,000,000 up to 1931, or a little less than 50 per cent. of the world's total. In 1931 it dropped to $3,250,000,000.

To produce $6,000,000,000 worth of minerals in the United States (and we have produced $6,500,000,000 worth) means that 2,000,000 workers were directly employed and 10,000,000 indirectly. If we include refining and fabrication valued at $15,000,000,000 we add 10,000,000 more workers. Distribution valued at $20,000,000,000 adds 5,000,000 more, and we find at last that in so-called good times the mineral industry accounts for the livelihood of 27,000,000 workers, who handle a total of $41,000,000,000 worth of mineral goods. In the 40 years from 1886 to 1926 the per capita mineral production in the United States increased from $7.78 to $53.34, or seven-fold. It dropped back to $47 in 1929 and $39 in 1930.

The last quarter of a century has seen most of this development. It is estimated that more fuel and more metals have been used during the last twenty-five years than during all the time that went before.[2]

What has been the South's contribution to this inter-

[1] Presidential address delivered on April 13 before the Alabama Academy of Science, twelfth annual meeting, State Teachers College, Florence, Alabama.

[2] Scott Turner, "The Mineral Industry," U. S. Bureau of Mines, Information Circulars Nos. 6643 and 6682.

esting and gigantic picture of the mineral industry in the United States? In round numbers the South accounted for 40 per cent. of the total mineral value ($973,938,000 in the South in 1932, compared with a country total of $2,443,000,000 in 1933.)

In the past twenty years the South has increased its mineral output by more than 160 per cent., while the rest of the country showed a gain of about 20 per cent. Petroleum and natural gas have accounted for most of this expansion. In 1910 the South produced less than 80,000,000 barrels of crude oil. In 1933, under regulated procedure, the South produced 622,625,000 barrels, or about 69 per cent. of the country's total output. Very little natural gas was used in the South in 1910, but by 1932 more than 1,063 billion cubic feet were consumed in the South. Gas and oil pipe lines now connect the producing Southwest fields and lower central South with many cities, including Birmingham, Chicago and many others. The South produces 68 per cent. of the country's total gas output and consumes about 58 per cent. of the total.

In 1933, the South mined 155,250,000 tons of coal, over 40 per cent. of the country's total. This figure was a slight increase over 1932 and was the first increase noted for several years.

In 1933, the South mined 2,159,000 tons of iron ore, and 2,197,000 tons of pig iron were produced. Scrap accounted for the difference.

Increased production in 1934 over the last few preceding years occurred also in coke, bauxite, lime, sulfur and fluorite.[3]

The South's mineral position is potentially very strong, and its minerals constitute one of its greatest assets. They are capable of supplying the raw material for almost any type of chemical industry. Many authorities are agreed that the South is destined to be the center of the nation's chemical manufacturing industry. Dr. Herty's recent triumphs with southern pine, coupled with the fact that federal funds may be available for such projects, means that newsprint paper and rayon manufacture from southern pine are probably a certainty. Bromine from sea-water in North Carolina is now being accomplished by the Ethyl-Dow Corporation in a $3,000,000 plant. The Southern Alkali Corporation has just invested $7,000,000 in a plant at Corpus Christi, Texas. A similar plant of like size was built last year by the Mathieson Alkali Works near Lake Charles, Louisiana. The TVA projects are in the offing.

A large part of more than forty minerals and their immediate products are supplied by the South. It produces practically all the bauxite, sulfur, phosphate rock, barite, lead ore and fuller's earth; over 50 per cent. of the feldspar, fluorspar, mica, zinc ore; one third of the asphalt, raw clay and lime; and about 14 per cent. of the steel and iron ore produced in the United States. The coal area of the South is double that of Europe, and five times that of Europe, excluding Russia. The red iron ore reserves of Alabama in 1925, as estimated by Burchard,[4] were 1,470,000,000 tons of first grade and 500,000,000 tons of second grade. Brown iron ore adds another 15,000,000 tons. At the 1927 rate of consumption this will last 335 years. He further estimates that there are more than 3,366,000,000 tons of coking coal, or more than enough to smelt all the iron ore.

The South has about 30 per cent. of the country's water power, and 21 per cent. of the stream capacity, according to the U. S. Geological Survey.

These facts look encouraging for the South, and much has been done in the past twenty years. Science has enabled the South to dominate the sulfur and phosphate industries. Synthetic nitrates made in the South have made this nation independent of foreign nitrate sources. A proper crop diversification, scientific utilization of its minerals and a return of a certain percentage of the unemployed to agricultural pursuits for a living and not for wealth will hasten the restoration of the South to a self-sustaining position equal to or greater than that enjoyed prior to the Civil War. Research on natural resources has hardly begun in the South.

The Present Mineral Policy of the United States

Future progress with this type of research means, among many other things, that our national mineral policy must be conducive to a constructive procedure. A brief survey of our present policy will not be amiss at this point.

The United States has always exerted less political control on minerals than any of the principal mineral-bearing nations. Private capital and initiative have always been permitted to develop their holdings in any way they pleased. Close examination will show, however, that increasing political attention has been given to the problem. After approximately nine tenths of the public land had been alienated from the government the United States General Leasing Act of 1920 was enacted to protect the remaining one tenth. This act placed marked restrictions on the freedom of acquiring and developing mineral resources by private capital. This act applies to all public lands known to have coal, petroleum, oil shale, phosphates and sodium and potassium salts. Ownership of the minerals was retained by the government and private capital was

[3] See Bluebook of Southern Progress for 1934, *Manufacturer's Record*, Baltimore, Md.

[4] E. F. Burchard, in *Iron Age* for March 24, 1927, pp. 847–853.

allowed access to them only in limited areas, and royalties were demanded. Before and since the act there have been further special withdrawals of minerals and mineral lands, such as potash, oil for naval purpose, helium for dirigibles, and others. The public mind was severely incensed at the naval oil scandals a few years back. In 1930 the leasing act was amended to permit leases of government lands to participate in unit operation of oil pools. This affected the South in Oklahoma and Texas by allowing all holders of lands above the sub-surface pool to share alike in expense and profit. There is more or less agreement among the leaders of the mineral industry that some such plan should be adopted by all mineral land-holders. Some think governmental supervision would be sufficient, while others favor governmental control.

The leasing act also contains a provision against the free participation of foreigners in the exploitation of our minerals, it being provided that foreigners shall not participate if their countries exclude Americans from similar participation.

The state of Minnesota now imposes such restrictions that comparatively few new leases on state iron ore lands have been made in recent years.

The acquisition of mineral deposits in the Philippines is limited to Filipinos and American citizens. Also, coal there can be mined only by leasing from the government. Still further, the Philippine government has taken direct financial participation in a company organized to develop coal resources.

Under the great land grants formerly given to railway and other companies the issuance of patents in the past few years has been made most difficult where the lands are suspected to be mineral-bearing. Suits have been brought by the government for recovery of minerals on lands previously patented under a land grant (vs. Southern Pacific R. R.).

Attempts have been made under the Sherman and Clayton Acts and by state anti-trust legislation to prevent monopolies. As mergers occur they are closely scrutinized to prevent monopolies. These rulings are doubtless preventing several super-combinations. The United States took legal action under the anti-trust laws against the Franco-German potash combine, winning what Leith[5] called a "hollow victory." The State Department has discouraged loans to the German potash industry and other foreign monopolies of raw materials.

The government has used commissions several times to control the coal industry. Much the same has been done with oil. The restriction of oil production now under way was suggested by the Federal Oil Conservation Board and is being in part carried out through the intervention of state governments. Nationalization of coal has been suggested by radical political parties and introduced in measures before Congress.

Taxes and tariffs are not to be overlooked as an indication of public control. Some of our minerals are now carrying heavy burdens of state taxation over and above those imposed on other business, on the specified or implied ground that the minerals really belong to the people, and, if allowed to remain in private ownership, they should be made to contribute special tax funds. Taxes of this variety are effecting the distribution of ore production in the Lake Superior region; and helping to eliminate the small miner in eastern Pennsylvania by the anthracite tax; and raising commodity prices by the Texas and Louisiana taxes on oil and sulfur; and causing similar results in Alabama by the tax on coal and iron ore; and doing similarly in Montana by the tax on coal and oil. Tariffs of ever-increasing size and number on mineral imports has been the policy of the government for the protection of new home mineral industries in order to make the country self-sustaining. The present administration is less inclined toward such a tariff policy; but the shipment of large quantities of German coke into Boston and German-made wire to Birmingham indicate that something needs to be done. Whether this shall be tariffs or government restriction or some other scheme is not quite clear just now.

In a few cases our government has participated directly in mineral development, as in drilling for potash in the Permian basin of Texas and adjoining states; the production of helium from natural gas in Texas and Kansas, and other projects.

These few remarks alone will serve to indicate the growing part the government is taking in the protection and development of our mineral resources. Let us turn our attention now to a new policy which has just been proposed to the President.

THE PROPOSED NEW MINERAL POLICY

This nation has been one of the last to realize the inevitable fact that mineral resources are exhaustible and not replaceable, and as this realization has slowly dawned upon the mind politic there has been a growing tendency toward government control, as I have just briefly outlined. However, such a haphazard program can not be continued indefinitely. The people must be made to see the facts, and our government must adopt some definite feasible mineral policy. The happy days of "skimming the cream" off of our mineral wealth are about over. High mining costs and relatively lower yields are with us.

The present administration is not unmindful of this, and accordingly President Roosevelt appointed in 1934

[5] Leith, "World Minerals and World Politics," McGraw-Hill.

a National Resources Board to survey the entire field of our natural resources. This board in April of that year appointed a Planning Committee for Mineral Policy consisting of Harold L. Ickes, *chairman;* C. K. Leith, geologist, University of Wisconsin, *vice-chairman;* W. C. Mendenhall, director, U. S. Geological Survey; John Wellington Finch, director, U. S. Bureau of Mines, also a geologist; and J. W. Furness, chief, Economics Branch, U. S. Bureau of Mines, and seven others. This planning committee has made its preliminary report covering, first, the need of a national mineral policy, second, a suggested policy in the domestic field, and third, the international aspects of the mineral policy. This report was released in mid-December, 1934.

In introducing this report the committee calls attention to the importance of the mineral industry and also to the fact that it has developed without the aid of any consistent mineral policy. The committee points out that the facts that warrant special consideration for the mineral industry, and a unified policy for its guidance, are:

(1) That minerals are exhaustible and non-reproducible; (2) that some minerals do not exist in the United States in quantities adequate for national welfare; (3) that others exist in present surplus; (4) that geographic distribution is fixed by nature and can not be changed by enactment thereby determining trade routes and trade areas, both domestic and foreign; (5) that there are special hazards, both physical and economic, in mining; and (6) that closing down a mine may result in losses far more serious than closing down a factory.

The *Engineering and Mining Journal*[6] points out that:

The most important public question rising from these conditions, recognized as basic by the committee, is that of conservation. The committee on mineral policy does not interpret conservation as hoarding but rather as an efficient and orderly use of minerals in the interest of the common good and national welfare, both in war and peace; and without unnecessary waste either of physical resources or the human elements involved in its extraction.

This newly proposed policy strikes a new and sympathetic note for the mineral industry. It points to a relationship between government and industry that should be mutually beneficial. It signals economic stability for the mineral industry and at the same time a conservation of natural resources. In short, the new policy proposes, according to a recent editorial in the periodical just cited, "self-control by the industry under public supervision of capacity, production, stocks, and sometimes of price, with periodic forecasts of demand by a governmental agency. . . ." This same editorial writer continues by saying, "This type of control is particularly appropriate to an industry dealing with a natural resource rather than a manufactured product, and is deemed necessary to stabilize the industry and protect the interests of the consumer, the wage earner, and the nation's long-time concern for conservation."

This proposed method of control is essentially that which has been attempted under the codes, even though it has not been fully realized. The committee recommends that the experience gained under NRA be used as a guide to future action. If one can place confidence in the published views of leaders in the mineral industry and the American Mining Congress then he is forced to conclude that the industry itself favors the extension of modified NRA control. Therefore "with evident harmony on the fundamentals of the problem, it should not be difficult to work out satisfactory details."

The Outlook for the Future of the Mineral Industry

The almost certain adoption of the proposed mineral policy so briefly outlined above sets one to speculating just what immediate effect it will have on the mineral industry in this country, and especially in the South.

It is confidently expected, in Washington, that this congress will establish a new National Planning Board to be named by the President as a permanent agency for the study of land, water-power and mineral problems of national concern. This recommendation is the most important item of the entire National Resources Board's voluminous report.[7] "Regardless of the economic or technical detail authorized by law, the setting up of a principle of national planning will mean the acceptance by the Government of the responsibility for a resources policy" (*Engineering and Mining Journal*). This has been a theory since the days of Theodore Roosevelt and Gifford Pinchot.

The Bureau of Mines will probably remain very largely a fact-finding agency, with enlarged funds and increased activity, regardless of the scope of the new policy board. An early increase in the funds available to the economics branch of the Bureau is to be expected. This means that more complete and prompt statistical services will doubtless result. The Science Advisory Board emphasizes the need for $16,000,000 to stimulate research and this is also important to mineral industries, because it includes a plan for the study of "mineral resources in their economic, social, and political relations, and particularly in regard to

[6] *Engineering and Mining Journal,* January, 1935.

[7] Report of the Planning Committee for National Policy, Part IV, pp. 58. National Resources Board, 1935.

conservation." Presumably this fund will be administered by the new National Planning Board.

The United States Geological Survey is scheduled to increase its activities tremendously, especially in the topographic branch, since the topographic mapping of the country is far from being completed and a good topographic base map is a recognized necessity for all research on natural resources.

The South can expect perhaps more than her proportionate share of this new research. The trend toward a chemical development of the South's resources is evident on every hand, as has been shown. Further development will depend upon the limitations set by the new policy, and this looks favorable at the present time. With the expected increased confidence it is reasonable to expect capital to be attracted southward. Let us hope that a scheme will be devised whereby state geological surveys will be materially strengthened financially, so that their long-delayed programs can be accomplished. Many of the funds now being spent for relief work could better be allocated for mineral location and research.

Since the war between the states the mineral industry in the South has been hampered not only by a lack of capital but several things that follow naturally from such a shortage; such as numerous small, poorly developed, widely scattered mines; and an emphasis on metals rather than non-metals. The development of coal, oil and gas in response to the heavy demand has far surpassed the other non-metals, but non-metallics have suffered most from inefficiencies of mining, milling and marketing. Yet long after metallics have been depleted the non-metallics will remain as strong valuable products.

The newly proposed mineral policy should encourage technological research in metallurgy, ceramics and industrial chemistry, and these researches will doubtless prove the value of many mineral deposits of medium and low grade, hitherto unworkable in the South and elsewhere.

To further this industrial march and to give these minerals the same impetus already acquired by coal, oil and gas, salt and sulphur, it is essential that the entire South be studied as a unit; that markets and centers of production be correlated; that basic freight rates and methods of assessments and taxation receive collective consideration; and that the great fuel supply of the South, coupled with its unexcelled water powers, should be utilized in the fabrication of raw material into finished products carrying higher class freight rates, but reaching new centers of distribution; employing men in a thousand small towns rather than in a few large cities; and offering increased valuations of property as an offset to constantly mounting taxes.[8]

The present slump is only temporary, if we can judge from history. In 70 years (1860–1929 inclusive) the population of the United States increased four times, agriculture production increased about six times, manufacturing increased about 22 times, while the mining output increased 60 times. Therefore, if our standards of living are to improve, as we expect they will, mineral production must also increase.

So in this march of events the South is definitely on its way. Just where we are going is not always quite clear, but let us hope that with the aid of the proposed new national mineral policy, intelligent conservation and a more thorough understanding of the limitations of nature, as well as her bounties, the South may continue to increase her "place in the sun."

THE GEOLOGIC AND THE COSMIC AGE SCALES[1]

THE AGE OF THE EARTH FROM SEDIMENTATION

THE method of estimating geologic time on the basis of sedimentation was of great value in the development of geology in the nineteenth century because it led to a better understanding of geologic processes and caused geologists to resist the distortion of their developing ideas of geologic history threatened by certain physical theories whose validity was insistently claimed by eminent authorities. The older calculations were, however, low minimal values produced under the influence of limitations urged by physicists, and based on the adoption of the comparatively high present rate of deposition as a constant rate and the neglect of critical considerations of certain factors which demand material time additions to the then accepted figures.

While the sedimentation method has a sound theoretical basis, it is, for the whole geologic record, complex and difficult of application, fundamentally because of varying rates, and the fact that to arrive at dependable approximate average rates for the different periods requires an extensive knowledge of the prevalent conditions during such periods that will be available only at some future date. At the present time we may say that a first rough approximation of specific rates for separate divisions of geologic history, taking into consideration formerly neglected factors, gives results of the same order of magnitude as the method based on radioactivity for the time from the

[1] Abstracts of the six papers of the joint Symposium of the Astronomical Society of the Pacific and the American Physical Society, University of California at Los Angeles, June 26, 1935.

[8] "The Undeveloped Mineral Resources of the South." American Mining Congress, 1928.

Cambrian to the present. Too little of the history and correlations of the pre-Cambrian have been sufficiently worked out to treat its sedimentary record in the same critical way.

The sedimentary method has, for certain short periods, developed a high degree of accuracy, but is not suited, unaided, to give satisfactory figures for the whole geologic record. Even with the acceptance of the present radioactivity determinations, it must still be used to determine the distribution of time in periods and epochs between the widely spaced points on the radioactivity time scale. It will be most useful to geology if it can be combined with an independent time method to determine its varying rates, for then it will give needed information as to the varying geological and geographic conditions valuable in the interpretation of the different periods of earth history.

GEORGE D. LOUDERBACK

UNIVERSITY OF CALIFORNIA,
BERKELEY

THE AGE OF THE EARTH FROM RADIOACTIVE DISINTEGRATION AND RELATED PROBLEMS

THE transformations of uranium, actino-uranium and thorium into isotopes of lead of atomic weights 206, 207 and 208, respectively, proceed at rates which have been accurately measured and which are not affected by extremes of temperature or pressure, by chemical reactions nor by the lapse of great periods of time, as is proved by the sharpness of the alpha rings in pleochroic haloes. The accumulation of helium and of the foregoing isotopes of lead gives a time scale of high precision. Reliable age measurements may now be made by the helium method on any small specimen of unweathered, fine-grained, basaltic material. Experiments seeking to extend this technique to coarse-grained granite and other materials are in progress.

The antiquity of nearly every geological period down to the Cambrian has now been determined. In addition, some thirteen pre-Cambrian formations are now dated, the oldest being 1,850 million years old.

The age of the earth can be estimated to lie between 1,850 and 3,500 million years. The ages of 23 iron meteorites, many of which are probably of extra-solar origin, do not belong to the solar system, are uniformly distributed between 2,800 million years and nearly zero, and show no tendency to group about any particular age.

ROBLEY D. EVANS

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

THE AGE OF THE EARTH FROM THE CHANGES IN ITS TEMPERATURE AND ELASTIC PROPERTIES

THE results which have been found concerning the age of rocks determine the time which has elapsed since the crystalline crust of the earth has formed. There is a gap which comprises the time between the formation of the earth and the beginning of the geological history. If the earth originated as a cold body, as Chamberlin believed, this time interval may be very large. If the earth was originally gaseous, the time until it formed a solid crust was relatively short, probably less than 100,000 years. In its early history the moon seems to have been very close to the earth, forming tides in the earth's crust which changed the surface layers of the earth to a large extent, so that the rocks which are now close to the surface solidified probably after these disturbances by the moon had decreased. The time elapsed since then can be calculated if the viscosity of the earth is known. Assuming the most probable values, we find times of the order of 10^9 to 10^{10} years; that is, the time when the moon was close to the earth is of the same order as the age found for the oldest rocks. Darwin and others have assumed that the moon originated from the earth. The only fact which seems to contradict this assumption is the high momentum of the moon; as long as this can not be explained, the hypothesis stipulating the origin of the moon from the earth can not be accepted. Jeffreys has found from the mechanics of such an event that in this case the moon must have originated at the time when the earth just began to solidify. In any case, the age of the earth which we find from the age of rocks is that which has elapsed since the moon was very close to the earth, unless the moon is a younger member of our solar system.

B. GUTENBERG

CALIFORNIA INSTITUTE OF TECHNOLOGY

THE AGE OF THE GALAXY FROM THE DISINTEGRATION OF GALACTIC STAR CLUSTERS AND BINARY STARS

As is well known, in modern astronomical literature, two values for the ages of the stars are found, which are frequently referred to as the short time scale (10^9–10^{10} years), and the long time scale (10^{12}–10^{13} years). Obviously, both can not be correct, and a choice between the two can be made only after critical examination of the basic computation. We find that the long time scale is without foundation and that the short time scale is compatible with our present astronomical knowledge.

Jeans has been, and still is,[2] the chief advocate of

[2] See discussion on the "Age of the Universe," *The Observatory*, April, 1935.

the long time scale. His five methods of estimating the ages of the stars will be discussed in more detail in a future paper. Two of these methods are erroneous, *viz.*, the method based on the comparison of the distribution of the observed eccentricities in visual binaries and a computed one; and that based on the mass-ratios of the binaries. A third method starts from concepts of stellar evolution which in all probability are incorrect, and two more methods depend on dynamical considerations that are incomplete and bound to lead to numerically incorrect results.

The study of the stability of galactic clusters has given the most reliable astronomical determination of the ages of the stars, and leads to the short time scale. The most complete investigation of this kind is Bok's paper in *Harvard Observatory Circular* 384, 1934; reference is made to Bok's own summary, *loc. cit.*, pp. 39–40.

Provisional computations by the writer on the stability of wide binaries tend to confirm the short time scale.

Finally, we have good reasons to suppose that stellar evolution on a large scale (involving great changes in mass, luminosity, and spectral type) have not taken place since the stars for the first time reached a "stable" state. This is irreconcilable with a long time scale.

It should be borne in mind that the age of the galaxy in its present form, which is equivalent to the average age of the stars, may be considerably less than the age of the universe.

G. P. KUIPER

LICK OBSERVATORY

THE AGE OF THE UNIVERSE FROM THE RED SHIFT IN THE SPECTRA OF EXTRAGALACTIC OBJECTS

BY the term "age of the universe" we can mean merely the time as measured on some particular conceptual clock back to a cosmological event of special interest or importance. For our present purposes we shall mean the time as measured on an ordinary clock in our own galaxy during which the extragalactic objects would have been observed to carry out the major part of their recession. There is nothing in this point of view contradictory to the idea that time may really be best regarded from a more fundamental point of view as extending from minus infinity in the past to plus infinity in the future.

With the help of the relativistic theory of gravitation, it is possible to investigate the behavior of homogeneous cosmological models, and curves are presented which show the different types of temporal behavior that would correspond to different values of the two parameters R_o and Lambda in the equations. It is emphasized that such models could at best be only a very rough approximation to the actual universe, but that their study may be informing in interpreting the behavior of that portion of the universe which has so far been observed. An essential feature of the models is the instability of any static distribution of extra-galactic objects and the consequent expansion or contraction which would be expected. An unessential feature of the models is the appearance of singular states of exactly zero volume which would not be expected to occur in the case of the actual universe which is certainly not perfectly homogeneous.

The expansion of such models would provide a natural and unforced explanation of the extra-galactic red shift. It is to be emphasized, however, that the possibility of other causes for the red shift has not yet been observationally eliminated. For the moment, regarding the red shift as due solely to expansion, we do not now have sufficient data to decide between the different possible types of expansion, but do have enough to reach the provisional conclusion that the major part of the past expansion has taken place during a time scale of the order of 10^9 to 10^{10} years. The rough agreement between this finding and the date for the laying down of radioactive material and for the birth of the planets is to be noted.

RICHARD C. TOLMAN

CALIFORNIA INSTITUTE OF TECHNOLOGY

ATTEMPTS TO RECONCILE THE LONG AND THE SHORT-TIME SCALES IN COSMOGONY

THERE exist extreme advocates of the long and of the short time scale, but neither side can offer an entirely convincing argument. The champions of the long scale calculate the time which the celestial systems needed to reach their present degree of uniformity and equilibrium. In the absence of definite knowledge as to how the universe came into being, it is, however, impossible to say what its initial state was and how much prior conditions in it differed from those we observe at present.

On the other hand, the proponents of the short time scale assume that the universe is now and always was fairly uniform and homogeneous, and compute the time during which it could have existed in this state.

It is clear that the two points of view start from assumptions so radically different that the results at which they arrive are in no way comparable.

PAUL S. EPSTEIN

CALIFORNIA INSTITUTE OF TECHNOLOGY

SCIENTIFIC EVENTS

THE ROYAL OBSERVATORY AT GREENWICH

THE astronomical correspondent of the London *Times* writes that on June 1, according to custom, the appointed Board of Visitors of the Royal Observatory met at Greenwich under the chairmanship of Sir Gowland Hopkins, president of the Royal Society, to make the annual inspection and receive the astronomer royal's report for the past year. With two exceptions all the 16 members of the board were present: J. H. Reynolds (president of the Royal Astronomical Society), Sir William Bragg, Professor Alfred Fowler, Sir James Jeans, Sir Joseph Petavel, Professor Sydney Chapman, Dr. H. Knox-Shaw, Sir Gerald Lenox-Conyngham, Professor Newall, Professor Stratton, Professor H. H. Plaskett, Sir Arthur Eddington and the hydrographer of H.M. Navy, Rear Admiral Edgell.

Dr. Spencer Jones, the astronomer royal, reports that with the old non-reversible transitcircle about 9,500 observations were made during the 12 months ended April 30. Included in these were 130 observations of the meridian position of the sun and 94 of the moon. The observations of the moon in 1934 continue to show a decrease in the difference in its position from that given by Brown's tables that were introduced in 1923. The correction to the longitude given by the tables, which was then seven seconds of arc, is now four seconds; and the progressive rate of the change may lead to knowledge of some further item in lunar theory.

Determination of stellar parallax, observation of double stars, and measurement of the variation of latitude, which are now staple work of the observatory, have been continued. The Yapp reflector with its spectrograph is used to take photographs to determine the temperature of stars by photometric measures of their spectrum, and has also been found specially useful during the past six months in the matter of Nova Herculis, the first photograph of which, it may be remembered, was taken with this instrument immediately after its discovery on the morning of December 13. An extensive work in hand is the measurement of the photographs of the small planet Eros, taken at various observatories in 1930–31 when near its opposition, from which it is expected a very precise value of the distance of the sun will be deduced.

As to the record of the sunspots that is kept at Greenwich, it is stated that sunspot activity has definitely increased, though somewhat irregularly from the solar minimum which happened during the latter half of 1933, but the sun's rising activity is more consistently shown by phenomena observed with the spectrohelioscope, an instrument or apparatus that has been comparatively recently added to the equipment.

Dr. Spencer Jones called attention to the long-mooted question whether Greenwich is now a suitable place for an observatory, and, in closing his report, sets down categorically some reasons to the contrary. The pollution of the air due to the surrounding industrial works and factories by the precipitation of sulphur-dioxide, soot and hard grit, is very detrimental to mirrors and other delicate parts of astronomical instruments; the condensation of moisture from hot gases ejected from near-by chimneys is a source of trouble and especially the use of mercury vapor lamps for street lighting lately introduced in the neighborhood is objectionable because the ultra-violet light they discharge affects photographic plates exposed at low altitudes.

INTRODUCTION INTO THE UNITED STATES OF DISEASE-RESISTANT PLANTS

MORE than 1,800 lots of seed from drought-resistant plants brought back from Turkestan by explorers of the U. S. Department of Agriculture are now growing in the plant reserve stations established last year by the department. Additional lots of seed have recently arrived from Manchuria and Mongolia, and still other valuable shipments are expected after the expedition now working on the edge of the Gobi Desert has had an opportunity to harvest the seeds which will ripen this fall.

An expedition headed by Professor Nicholas Roerich was sent to the areas bordering the Gobi Desert because of the great pasture areas which apparently withstand the heat of summer, the cold of winter and the scanty rainfall. Through centuries of natural selection strains of grasses and legumes which are able to cope with these conditions have developed and increased. Also, the origin of many plants has been traced to the old world centers in Asia and it is reasonable to expect that there are already in existence grasses, legumes, shrubs and trees that would be of value under similar conditions in the United States. No region in the world offers more promise of obtaining economic plants which are drought-resistant, soil-binding and otherwise peculiarly important at this time. The discovery of just one desirable plant species would repay the costs of the expeditions many-fold.

The semi-desert has the appearance of a large plain with an altitude of approximately 2,000 feet. The climate of the region is characterized by a "snowless, rigorously cold winter, a cold and rather rainless spring and autumn, and a hot dry summer, for

although there is more rain in the summer, the water quickly evaporates, owing to the heat which sometimes reaches over 100° F." In this region were recorded species of important plants such as wheat grass, brome grass, blue grass, rye grass, fescue, alfalfa, lespedeza, and other lesser known species of possible value. About twenty different grasses and four species of shrubs were reported, but no trees were recorded in this section.

In addition to the plains region, considerable areas of unstable and in some places movable sand dunes were encountered. The greater part of the sand dunes were more or less covered with turf. Various species of wheat grass including *Agropyron pseudoagropyrum*, blue-joint, June grass, foxtail, alfalfa, clovers and other lesser known grasses, shrubs and trees were reported in this region.

The bench lands in the river valleys are covered with perennial grasses, shrubs and trees which are "able to withstand, without any failure," the winds, the heat and the cold. Various species of Spodiopogon, Arundinella, Digitaria, Stipa, Calamagrostis, Koleria, Melica, Festuca, Bromus, Salix, Quercus, Ulmus, Rosa, Armeniaca, Medicago, Astragalus, Vicia, Securinega and Thymus were reported.

Seeds of the plant species already obtained from the Roerich expedition and now being grown in experimental greenhouses include Stipa or needlegrass, Agropyron or wheat grass, including the species pseudoagropyrum, lespedeza, trifolium and elymus or rye grass.

THE UNION CATALOGUE OF MEDICAL LITERATURE

Two years ago the Institute of Medicine of Chicago made available an initial fund for the establishment of a union catalogue of medical literature in Chicago. The work of organization of this project was entrusted to a Committee on Coordination of Medical Libraries in Chicago, which had been appointed a year before.

The first aim of the committee was to bring about closer integration of effort among the major medico-biological libraries, including dental and pharmacological, of the city (John Crerar Library, Universities of Chicago, Illinois, Northwestern and Loyola, Rush Medical College) to obviate unnecessary duplication, triplication or even quadruplication of special literature, and divert the economies achieved to a fuller representation of the world's medical literature in Chicago. The second aim was the creation of a union card index centrally placed, so that investigators in medical problems are able to locate the desired reference volumes with the least expenditure of time and energy.

It is hoped that eventually the service of the catalogue will be made even more effective by the attachment of a permanent librarian and the availability of information by telephone. The task of achieving such a union catalogue and its cost in effort and money are much greater than the original estimates indicated. The work towards its completion is still in progress, but is pushed as quickly as possible. Every month these different medical libraries are sending in the cards of their new acquisitions, so that the catalogue is brought to date. It is hoped that in time the important holdings in the smaller medical libraries in the city will be represented in the catalogue.

The final editing of this union index may not be accomplished before another two or three years have passed. Despite its present gaps and imperfections, it has already given valuable service to the medical librarians of the city, and to investigators who were aware of its existence. The union catalogue is now open to a wider medical public, which is invited to make use of it for reference and to cooperate in its further development and extension of service. It is to be found on the twelfth floor, or floor of the medical reading rooms, in the John Crerar Library.

Further information concerning it may be obtained from the medical librarians indicated above, or from the central office of the Institute of Medicine of Chicago, 629 South Wood Street. Criticisms or suggestions should be sent to the latter. The chairman of the committee is Professor Otto F. Kampmeier, department of anatomy, College of Medicine, University of Illinois, Chicago.

THE MYCOLOGICAL SOCIETY OF AMERICA

THE summer foray of the Mycological Society of America will be held at Ithaca, N. Y., from August 20 to 23, inclusive. The mycological laboratories of Cornell University on the third floor of the Plant Science Building will serve as headquarters. The local committee in charge of arrangements will consist of Professor H. M. Fitzpatrick and Professor H. H. Whetzel. The Ithaca members of the society extend a cordial invitation to all mycologists to attend. Lodging and meals will be provided at reasonable rates at rooming houses bordering the campus and at the university dining halls. Camp sites are available nearby for any who desire to use tents.

Ithaca is located in the scenic Finger Lakes region of central New York at the head of Cayuga Lake, and is well known to botanists for the natural beauty of its surroundings and the richness of its flora. Within easy reach are fresh-water marshes and lakes, peat and marl bogs, numerous small gorges with many waterfalls, upland woods and open fields. High hills afford a variation in elevation of more than fifteen

hundred feet with a corresponding difference in flora. In most seasons fungi occur in profusion, and in only the most unusual August is the collecting unsatisfactory. Pleasant days and cool nights are to be expected. The laboratories are well equipped with facilities for handling the materials collected. The herbarium, containing the specimens of Atkinson and his students, is available for consultation.

Members of the society and other students of the fungi are urged to make careful note of the dates of the foray and to arrange their summer plans to include it. All who plan to attend are asked to advise the local committee well in advance in order that adequate arrangements may be made.

THE REORGANIZATION OF THE NEUROLOGICAL INSTITUTE OF NEW YORK CITY

DR. FREDERICK TILNEY, professor of neurology at the College of Physicians and Surgeons of Columbia University, was elected medical director of the Neurological Institute, at a meeting on July 9 of the board of trustees, of which Floyd B. Odlum is president.

Dr. Tilney has been associated with the Neurological Institute since 1919, serving recently as chairman of its committee on medical research. The medical directorship is a new position, and according to plans for the reorganization of the institute two assistant medical directors to conduct special departments will be appointed.

The institute was founded in 1909, reorganized in 1920, and in 1929 was moved to its present location as one of the units in the Medical Center. It is now proposed to develop an entirely new department in the institute and to organize it in association with the College of Physicians and Surgeons so that it would be in a position to concern itself with the physiology of the nervous system. Plans are also being made to enlarge the department of child neurology, recently organized under the directorship of Dr. Bernard Sachs, by means of a gift from the Friedsam Foundation. Plans are also under way to extend laboratory facilities to several additional floors in the institute.

At the recent meeting the number of the trustees was increased from twenty-five to fifty. Dr. Dudley Roberts was elected vice-president and was appointed chairman of the executive council, ten of whose members are chairmen of newly established committees, as follows: scientific activities, Dr. Roberts; hospital management, Charles F. Neergaard; professional staff, Dr. Cassius H. Watson; nursing, Mrs. Henry P. Davison; out-patient department, Gordon Abbott; buildings and grounds, Maurice Wertheim; publicity and community relations, Mrs. Ogden Reid; law, Harold B. Thorne, Jr.

Under the revised rules, the institute will maintain a hospital, emergency service and out-patient department for those suffering from nervous troubles, with free service for those who are unable to pay; provide facilities for the training of undergraduate and post-graduate medical students in the treatment of mental disease and instruction of nurses in the care of such patients, and provide for study and research into the causes, preventive methods and treatment of nervous diseases.

MEMORIALS AND RECENT DEATHS

A TABLET in memory of Dr. Clarence H. Eckles was presented to the University of Minnesota on June 15 by the dairy interests of the Northwest. Dr. Eckles was chief of the Division of Dairy Husbandry at the University of Minnesota from 1919 to 1933. The tablet is placed in Haecker Hall, the Dairy Building at the Minnesota Agricultural Experiment Station, St. Paul, which Dr. Eckles was instrumental in securing for the College of Agriculture.

ACCORDING to *Nature,* the admirers, friends and pupils of the late Dr. Émile Roux, director of the Institut Pasteur in Paris, have decided to establish a national fund to be known as the Roux Foundation to pay the expenses of young students of biology. The general secretaries are M. Sieur, Inspector-General of the French Army, and Professor Marchoux, member of the Academy of Medicine. Subscriptions should be sent to the treasurer, M. Dufaure, 205 rue de Vaugirard, Paris.

DR. MARION DORSET, co-discoverer of the serum to prevent hog cholera, who had been chief of the biochemic division of the Bureau of Animal Husbandry of the Department of Agriculture since 1904, died on July 14 at the age of sixty-two years.

A. F. WYNN, for nearly twenty years curator of the Lyman Entomological Collection and Library at McGill University, died on July 3.

DR. DANIEL H. SQUIRE, dean of the University of Buffalo School of Dentistry since 1912, died on July 6.

Nature records the death of Colonel W. C. Blackett, past president of the Institution of Mining Engineers and of the North of England Institute of Mining and Metallurgical Engineers, on June 13, aged seventy-five years, and on June 19 of W. S. Franks, who, for twenty-five years, was in charge of the Brockhurst Observatory, East Grinstead, known for his work on the colors of stars, aged eighty-four years.

SCIENTIFIC NOTES AND NEWS

DR. HERBERT SPENCER GASSER, since 1931 professor of physiology and director of the physiological laboratories of the Cornell University Medical College, New York City, previously professor and head of the department of pharmacology at Washington University, St. Louis, has been appointed to succeed Dr. Simon Flexner as director of the laboratories of the Rockefeller Institute for Medical Research.

DR. WILBUR A. SAWYER, associate director of the International Health Division of the Rockefeller Foundation, has been appointed director to succeed Dr. Frederick F. Russell, who will retire on September 1 because of the age limit. Dr. Russell has been appointed lecturer on preventive medicine and on public health at the Harvard Medical School and the Harvard School of Public Health.

DR. RALPH S. MUCKENFUSS, assistant professor of medicine in the School of Medicine of Washington University, St. Louis, has been appointed temporary assistant director of the Bureau of Laboratories of New York City. It is expected that the assistant director will be later the successor of Dr. William H. Park, professor of bacteriology and hygiene at New York University, who is director of the Bureau of Laboratories. Health Commissioner John L. Rice is reported to have said: "It has been a difficult job to find a younger scientific investigator to serve as understudy to Dr. Park, one who holds out promise to maintain the Health Department's laboratories at the high point of scientific attainment developed by Dr. Park. The position of associate director carries a salary of only $6,000 and demands the appointee's full time and thought. A careful search was first made in New York City for a qualified person who would accept the position at the available salary. A number were approached, but all declined. We then canvassed the entire country, and the result is the appointment of Dr. Muckenfuss."

THE Roosevelt Medal for 1935 has been awarded for "distinguished service in the administration of public office" to Dr. William H. Park, director since its establishment in 1894 of the Bureau of Laboratories of the Health Department of New York City. The citation reads in part: "In that capacity he has worked with rare wisdom and devotion for the public health. He ranks as the leading bacteriologist in the United States. His achievements in the field of preventive medicine have been recognized by authorities not only in this country but abroad. The laboratory which he organized has been described as 'the first in the world in which the discoveries of Pasteur and Koch were systematically applied to the protection of public health' and for forty years has remained a model scientific institution, unaffected by political changes in the city government." The citation continues: "Dr. Park's most conspicuous service has been in 'the conquest of diphtheria,' he being the first to introduce into this country the antitoxin, and being 'mainly responsible' for the reduction of the death rate from diphtheria from 295 to less than 3 per 100,000. He also has been a pioneer in the discovery of the part played in the spread of communicable disease by carriers who are themselves not infected."

THE medal of the British Society of Chemical Industry was presented to Dr. E. F. Armstrong, "for conspicuous services to chemistry," at the annual meeting of the society held in Glasgow from July 1 to 6. On this occasion Dr. Armstrong delivered an address entitled "The Past, the Present and the Future."

THE Osler Memorial Medal, which is awarded every five years to the Oxford medical graduate who has made the most valuable contribution to the science, art or literature of medicine, has been awarded to Dr. Arthur F. Hurst, senior physician to Guy's Hospital. London.

AT the recent congress of the German Society for the Study of the Circulation, the Karl Ludwig Medal was presented to Professor K. F. Wenckebach, of Vienna, for his work on diseases of the circulation.

AT the one hundred and fourteenth annual commencement exercises of Colby College, the degree of LL.D. was conferred on Dr. Clarence C. Little, director of the Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Me., the commencement speaker. The doctorate of science was conferred on Dr. George H. Parker, emeritus professor of zoology at Harvard University, and on Dr. Marston Morse, who this year goes from Harvard University to accept a chair at the Institute for Advanced Study at Princeton.

DR. PETER DEBYE, professor of experimental physics at Leipzig, has received the honorary doctorate of the University of Liège. On June 26 the degree of doctor of science was conferred on him by the University of Oxford.

AT the congregation of the University of Leeds on July 1, the degree of LL.D was conferred on Lord Rutherford, professor of experimental physics and director of the Cavendish Laboratory at the University of Cambridge; on Dr. William Stroud, Cavendish professor of physics, emeritus, at the University of Leeds and, *in absentia,* on Dr. Harvey Cushing, Sterling professor of neurology at Yale University.

PROFESSOR CORNELIUS WINKLER, emeritus professor of neurology and psychiatry at Utrecht, has recently celebrated his eightieth birthday.

DR. ARTHUR H. COMPTON, professor of physics at the University of Chicago, and Manabu Miyoshi, professor of botany at the University of Tokyo, have been elected corresponding members of the Vienna Academy of Science.

PROFESSOR J. GRAHAM KERR, Regius professor of zoology in the University of Glasgow, has been elected member of Parliament for the Scottish Universities. The voting was: Professor J. Graham Kerr (National Government), 20,507; Mrs. N. Mitchison (Labor), 4,293. *Nature* states that Professor Kerr's election involves giving up the chair of zoology, which he has occupied since 1902.

THE Washington Society of Pathologists recently held a farewell banquet in honor of Major Virgil H. Cornell, retiring curator of the Army Medical Museum and secretary-treasurer of the society. Lieutenant-Colonel William Denton, who has been appointed curator, has also been elected secretary of the society.

THE Chicago Chemists' Club held a luncheon on July 2 in honor of Professor L. Ruzička, of the Technische Hochschule, Zurich. Professor Ruzička is a visiting professor in the department of chemistry of the University of Chicago, where he is presenting two series of lectures during the summer session.

DR. DONALD C. BALFOUR, professor of surgery at the University of Minnesota Graduate School of Medicine, Rochester, has been appointed to the newly established position of associate director of the Mayo Foundation.

DR. STANTON C. CRAWFORD has been appointed dean of the college at the University of Pittsburgh. He succeeds Dean Herbert L. Spencer, who recently resigned to become president of the Pennsylvania College for Women, Pittsburgh. Dr. Crawford was formerly professor of zoology at the university and has been director of high-school relations since 1933.

DR. CHARLES LEONARD BROWN, associate professor of internal medicine at the University of Michigan Medical School, has been appointed professor and head of the department of medicine of the School of Medicine of Temple University. He succeeds Dr. John A. Kolmer, who resigned recently.

DR. RUDOLF THEODORE KEMPTON, research associate at the University of Pennsylvania, has been appointed assistant professor of biology at Princeton University.

AT the University of Washington the regents have created separate departments from the former department of geology and geography. Dean Henry Landes will continue as head of the department of geology and Dr. Howard H. Martin will be head of the new department of geography.

DR. DAVID ROCKWELL GODDARD, for the last two years a National Research fellow at the Rockefeller Institute for Medical Research, New York, has been appointed instructor in botany with special reference to plant physiology at the University of Rochester. He will be associated with Dr. Wm. D. Merrell, chairman, in the development of the work in the newly established (1933) department of botany.

DUGALD C. JACKSON, JR., head of the department of electrical engineering at the University of Kansas, has been appointed director of the Lewis Institute, Chicago. His resignation from the faculty of the University of Kansas will not become effective until the end of the fall semester, however, and he will spend six of the 18 weeks of the semester as a part-time professor at the university. Lewis Institute is a coeducational polytechnical school. Its four main divisions are engineering, business administration, education and home economics and it also has pre-legal and pre-medical courses.

THE Josiah Macy, Jr., Foundation has made a grant of $4,000 to Purdue University, to support psychological research in the genetics of attitudes by Dr. H. H. Remmers, director of the Division of Educational Reference.

DR. EDWARD A. DOISY, professor of biochemistry and director of the department at the School of Medicine at St. Louis University, sailed for London on July 5 to attend a meeting on July 15 as the representative from the United States of the permanent commission on biological standardization of the League of Nations.

DR. CHARLES N. FREY, director of the Fleischmann Laboratories, New York, has been appointed a delegate to the fourth International Technical and Chemical Congress being held at Brussels from July 15 to 28.

PROFESSOR OTFRIED FOERSTER, of Breslau, will deliver the Hughlings Jackson Lecture, under the auspices of the Royal Society of Medicine, London, on July 31.

Nature writes: "The first Sharpey-Schafer Memorial Lecture, given on June 21 by Sir Charles Scott Sherrington, was a notable tribute paid to the late distinguished physiologist by his fellow-worker and friend. Sir Charles referred more particularly to Sir Edward Sharpey-Schafer's work in endocrinology and in neurology, and dwelt on the great interest and importance of the observations made by Schafer in 1877 on the nerve-elements in the jelly-fish *Aurelia*, and in

his later work on localization in the cerebral cortex and on the structure of the spinal cord."

DR. PAUL F. RUSSELL, of the International Health Division of the Rockefeller Foundation, recently gave a series of lectures on the epidemiology of malaria at the second International Malaria Courses of the League of Nations in Singapore. After a short leave of absence he will take up work at the King Institute of Preventive Medicine, Madras, in connection with malaria investigations in South India.

AMERICAN delegates to the Berlin meeting of the International Commission on Illumination include: F. C. Breckenridge, National Bureau of Standards, Washington, D. C.; A. F. Dickerson, General Electric Company, Schenectady, N. Y.; C. D. Fawcett, University of Pennsylvania, Philadelphia, Pa.; Charles Franck, Holophane Company, Inc., New York City; Heman Greenwood, International General Electric Company, Schenectady, N. Y.; John Kliegl, Kliegl Bros., New York City; M. G. Lloyd, National Bureau of Standards, Washington, D. C.; A. L. Powell, General Electric Company, New York City; G. B. Regar, Philadelphia Electric Company, Philadelphia, Pa.; C. H. Sharp, White Plains, N. Y., and Walter Wagner, Philadelphia Electric Company, Philadelphia, Pa.

SCIENTIFIC departments at Augustana College, Rock Island, Ill., have been transferred to their new quarters in the Wallberg Hall of Science, a building made possible by a bequest of more than $200,000 from the estate of the late Marie Wallberg and her brother, the late Emil Wallberg, of Toronto, Canada. In the new building, which is constructed of Indiana limestone and of tile finish within, the departments of botany, zoology and physiology will be accommodated on the first floor, physics and geology on the second and chemistry on the third. A fourth floor provides considerable space for future expansion. In the basement are a machine shop and workshops for the departments of physics and geology, as well as general stock rooms and unassigned space. A service elevator runs from the basement stock rooms to the various departmental store rooms on the upper floors. A general lecture hall and scientific library on the first floor will be utilized by all departments. Throughout the building is equipped with new laboratory furniture of the most modern design, and much new scientific equipment has also been added. Dedication of the Wallberg Hall of Science took place on June 6, on which occasion addresses were given by Dean George A. Works and Professor Anton J. Carlson, both of the University of Chicago. Dr. Carlson is an alumnus of the institution.

PRESIDENT ROOSEVELT has allotted $13,713,117 to the Bureau of Entomology and Plant Quarantine for eight projects for disease and insect control. The latter included $2,376,920 for control of black stem rust by eradication of certain types of barberry bushes in seventeen states, producing large quantities of small grains; $970,000 to combat the spread of the brown-tail moth, now attacking shade trees in New England, and $2,800,000 for control of the gipsy moth, also in New England. The allotments for brown-tail moth control included $13,313 for Connecticut. For gipsy moth control the allotments included: Connecticut, $496,664; Pennsylvania, $792,288; New York, $172,299, and New Jersey, $72,664.

ACCORDING to an Associated Press dispatch, the Department of Agriculture has requested a Federal appropriation of $2,750,000 with which it is believed that the elm tree disease can be controlled. It is urged that unless the infected trees within the quarantined area are found soon and destroyed by fire the disease may spread. It is said there are more than 400,000 trees known to be diseased and tagged for destruction. Officials of the Bureau of Entomology and Plant Quarantine report that despite efforts of field crews the infection is spreading faster than the bureau's force can keep track of it. Workers must be taken from relief rolls, so that the department can not reemploy trained personnel. William B. Duryee, secretary of the New Jersey Department of Agriculture, has written to the state's congressional delegation urging aid to obtain additional Federal appropriations. He states that the requirement that workers be taken from relief rolls hampers the work, which requires trained technicians, scouts, climbers and foremen, as well as experienced laborers.

IT is reported that Chinese philanthropists will contribute a million silver dollars toward the medical center in Shanghai to be established in cooperation with the Rockefeller Foundation. Construction of the new buildings will be started late this summer on a site in the French concession. The cost of the plant, including land, will represent an outlay of about $2,000,000.

AFTER five years of negotiations with the Grand Lama of Tibet the American Museum of Natural History has obtained permission to send a scientific expedition across the closed Tibetan frontier into the forbidden hinterland of Asia. The Grand Lama's consent was obtained by Suydam Cutting, a member of the board of trustees. Mr. Cutting sailed on June 29 for London. In England he will be joined by Arthur S. Vernay, who recently returned from an American Museum expedition to Burma. Together they will fly to Calcutta, India, proceeding to Tibet by way of Sikkim. From that point they will make their way,

through the three-mile-high passes of the Himalayas, by horse and mule to Shigatse, a short distance from the sacred city of Lhasa. In Tibet the expedition will collect anthropological material for the American Museum and botanical specimens for the New York Botanical Garden. Out of respect for Buddhist tradition, which holds all living things sacred, no animals or other living creatures will be removed.

DISCUSSION

HUMAN REMAINS IN GRAVEL NEAR WEST UNION, MINN.

THE record of recent discoveries as reported in SCIENCE indicates that Minnesota is unusually rich in the remains of early man. A skeleton recently uncovered in West Union Township, Todd County, appears to belong to this group, although there are various uncertainties that need to be solved by further study.

A gravel pit on the land of Daniel W. Fraser (Lot 1, N E 1/4 Sec. 11 T. 127 N., R 35 W.) has been the source of gravel for the improvement of certain roads. The gravel is dug by hand and the ordinary procedure is to shovel from the base of a face 20 feet high. Once or twice a day the men go up on top, spade the loam from a strip 2 to 3 feet wide, throw it to one side and then cave down the bank. A considerable number of men with Ralph Smith as foreman, were employed, including Romaine Johnson, Ludwig Elven, Melvin Irwin, Earl Tompkins, Martin Brakken, Bob Iverson, and Teddy Randall. These men are agreed that the first unusual fact that attracted notice was a bone, afterwards identified by me as the tibia, that projected from the bank about 3 to 4 feet below the top. This bone lay in undisturbed gravel and fell or was pulled out and two smaller bones came with it. Later, on June 11, 1935, two men were on top, stripping and caving when the spade of Earl Tompkins struck bones and at the instant that he saw them, a large mass of gravel fell down the bank carrying the bones to the bottom of the pit. As this occurred at the end of the day the men quit work, and did not realize that a skeleton had been brought down until the next morning, June 12, when they picked the skull and bones out of the gravel. On that day I obtained the bones from the owner of the pit, and interviewed the men. The next day I took photographs of the site and on June 17 recovered from the waste pile two of the first bones seen. At various times I searched the road on which the gravel had been dumped and recovered small fragments of bone.

The gravel pit lies on a ridge which is part of the southern boundary wall of the flat-bottomed valley of Sauk River. The upper 7 feet of gravel in the pit consists of bedded fine and coarse gravel much iron-stained, which I call the West Union gravel. It rests unconformably on till at the south end of the pit and on slightly deformed gray gravel at the north end where the skeleton was found. Similar gravel is exposed in a pit on the top of the next ridge 700 feet southwest, but elsewhere it has not been found. Geological alternatives are as follows: (1) Is this gravel part of a more wide-spread deposit of a stream or streams later than the lower till and gravel? (2) Is this gravel only a part of the till which has been exposed at this place by erosion?

Archeologically, it is unfortunate that conclusive evidence by trained observers is not available as to the disposition of the bones in the gravel. The men estimate the depth of the bones from 16 inches to 4 feet. They agree that the bones lay well below the loam which is a foot thick and that the well-stratified gravel appeared to them to be undisturbed.

If the West Union gravel is a stream deposit later than the till (Hypothesis 1 above) it is Postglacial in age and the skeleton may be contemporaneous with it. One would have to suppose that a man was killed or died on the banks of the stream and his body entombed by natural processes.

On the other hand if the West Union gravel is part of the morainic complex, a mere fragment of gravel caught up and embedded in till, it dates back to the Bemis stage of the Keewatin Ice-sheet ("New Gray Drift") or may even be of "Iowan" age ("Old Gray Drift"). The relatively modern type of the skull makes contemporaneity with such comparatively old deposits unlikely. One would have to suppose that the man was buried in the gravel and that the evidence of a grave passed unnoticed by the workmen.

Further studies of the geology are planned. The skeleton is to be referred to a competent physical anthropologist.

HENRY RETZEK

THE RECTORY
ST. ALEXIUS CHURCH
WEST UNION, MINN.
JUNE 30, 1935

KILLARNEAN AND EARLIER GRANITE

PROFESSOR A. C. LAWSON has a note, "Is the Killarney granite different in age from the Algoman?" in SCIENCE for May 24. Lawson does not doubt that radioactive measurements are of geologic value, for as chairman of the Division of Geology and Geography of the National Research Council he himself organized

the committee to study them. But he calls for more evidence that the Killarnean, of which he doubts the Keweenawan age because it is cut by a swarm of Keweenawan dikes, is other than the Algoman.

At Killarney it is, I found (in an unpublished report of a trip I made with Ellsworth for the Canadian Survey before Lawson visited the region), associated with porphyries, as Lawson later pointed out. I did not find it at Killarney cut by diabase dikes. There are porphyrites north of it which I think are Keweenawan, but they do not seem to cut, but to conform in strike. I wish we could visit the region together. Even if it were cut by such dikes they would not show that it was not Keweenawan. I remember looking over some drill cores of the Onondago Copper Company in the Porcupine Mountain region (Hole 7 see 4–49–42 at 1,408 feet) close to Keweenaw Point and being surprised to find a basalt dike cutting the Keweenaw rocks. F. E. Wright and I found another intrusion in the Chippewa felsite which is the core.

The latest Keweenawan for which Urry has yet given age data is, I think, the north and south dike of the Horne mine (Noranda). This is the kind of dike to which Lawson refers. It is 510 ± 25 million years old. On the other hand, a normal dike of the Gogebic range is 560. But this dike is cut and displaced by a sill and may, as L. M. Scofield, S. Royce and others suggest, be very late Huronian (Animikie, neo-Huronian). The ages of the flows of the mines of Keweenaw Point vary from 550 (Champion) to 520 (Atlantic) million years old. These dates cover at least two periods of wide-spread felsites and disturbances (not to mention the valuable suggestions of Broderick just made in "Economic Geology")—(1) Conglomerate 8 and the felsites of Mount Houghton and (2) Conglomerate 16 and the Chippewa felsite of Porcupine Mountain. But the Lake Shore traps are later with thousands of feet of strata separating and might be of the age of the Horne dike. In this letter I can not try to enter into the connections with the Duluth gabbro invasion and disturbances of late Keweenaw age studied by H. R. Aldrich and the Embarrass and the Presque Isle granites to which I referred (*American Journal of Science,* 1917, pages 42 to 48) nor the Republic (Lamey) and the Mellon (Richarz), more recently studied. Obviously there is time in the Keweenaw for various dates of granite intrusions. As Killarnean may have been included granites of substantially different ages which might yet all be Keweenawan.

But I agree with Lawson that these granites lap closely on the base of the Paleozoic, the top of the Upper Cambrian (the kolm), having been formed about 400 million years ago. Indeed I am inclined to consider some Cambrian. Lawson has suggested[1] that the Algoman is some 218 million years earlier than the Keweenaw and Animikie, separated long enough for its profound peneplanation. Not to go beyond North America into Norway and Africa, there are such earlier granites. We may instance that represented by the Besner uranite, of which we have 3 or 4 lead ratios and an atomic weight, and the age is not far from 800 million years.

I imagine this and similar granites cutting only part of the Huronian would be Lawson's Algoman, for these are distinctly younger than another group of granites cutting the Grenville limestone, which are the original Laurentian granites represented by Wilberforce, Pied des Monts, Villeneuve, etc., about a thousand million years old. Out West there seem to be granites much older, Kewatin and pre-Kewatin, not yet distinctly recognized in Eastern Canada.

ALFRED C. LANE

TUFTS COLLEGE

THE MELODIES OF VERSE

POETIC melodies tend, in good reading, to arrange themselves in patterns which coincide with the phrase or the line, and these patterns are often repetitive. Melody, furthermore, often emphasizes the poetic rhythm and the stanzaic structure, and prepares a sort of cadential effect for the end of a passage. These characteristics, often suspected, have been proved by phonophotographic researches into the nature of verse, which are being conducted this year under the auspices of the American Council of Learned Societies. The researches have revealed also a third characteristic: riming words tend to be pronounced on the same pitch.

The tendency of two riming words to be pronounced on the same pitch was noticed in an excellent reading by a distinguished American poet of a poem by Herrick. The mean frequencies of the riming words were as follows:

Word	*Mean frequency, d.v.s.*
eyes	235
skies	230
see	275
free	268
hair	250
air	248
wear	225
ear	232
stone	178
gone	172

This was all the more remarkable because the reader's pitch range for this poem was an octave and one half, and in one instance he had to jump seven tones in order to make his rimes correspond in pitch.

[1] *Bull. Geol. Soc. Am.,* 1934, p. 1069.

We sought to verify this observation by asking a young Englishman, a graduate of Cambridge and the author of several books of verse, to read the same poem twice, at an interval of about one hour. In order to see whether the characteristic might be individual to the poem, we asked a young woman from Oregon and a young man from Louisiana to read very different poems into our recording apparatus. When we were through we had phonelescopic pitch-records of samples of verse from three centuries, which had been read by competent people as far removed as England and Oregon. In all these cases the greatest difference observed in the pitches of any pair of rimed words was 17 d.v.s. (which, in that register, represented about one half tone), and the average difference was 5 d.v.s., or about 2.5 per cent. It was also noticed that pitch-patterns of riming words tend to be similar and that the riming vowel tends to be pronounced on or near a sub-multiple of the characteristic frequency of that vowel.

This characteristic of the melody of verse is now being investigated more fully in the Iowa laboratories. If the results reported in this note are corroborated they may contain a key to the little understood problem of poetic melody.

WILBUR L. SCHRAMM

UNIVERSITY OF IOWA
PSYCHOLOGICAL AND PHONETIC LABORATORIES

EFFECT OF CORTIN ON INTRA-OCULAR TENSION IN GLAUCOMA

I HAVE found that the heightened intra-ocular tension of simple glaucoma responds with startling promptness to the administration of the adrenal cortex hormone, cortin. In cases which are uncomplicated by degenerative changes of the ocular tissues, even though of long standing, drops of pressure from levels as high as 50 mm of mercury (Schiotz) to normal level have been noted in the period of half an hour, after injection of cortin. Parallel to this drop in tension, there occurs a rise in visual acuity, often to normal level, and relief from the sense of tension and pain.

These findings throw a new light on the mechanism of the rapid changes of intra-ocular tension in glaucoma, and enables a better comprehension of the puzzling features of the symptomatology of the disease. For the work of Swingle, Pfiffner and others has shown that deficiency of cortin results in increased permeability of the capillaries and vessels to the water and mineral content of the plasm. Rapid increase in secretion of fluid into a densely encapsulated organ such as the eye would result in a rapid rise of the tension. In the same manner can be explained the response to cortin therapy of deafness associated with increased intra-ocular tension and Meniere's syndrome.

Response of progressive myopia to cortin therapy leads to the hypothesis that the mechanism of this disorder is similar to that of glaucoma, a disturbance of the water-salt metabolism. The difference in the end-result is explainable in terms of elasticity of the tissues of the eye; the more elastic sclera of the younger eye yielding and stretching into the myopic state, and the less elastic sclera of the older eye forcing a giving-way and compression of the less dense tissues of the parenchyma of the eye, optic nerve disk and ciliary body.

This hypothesis on the nature of myopia is borne out by the finding of a group of cases of progressive myopia in school children which present the symptomatology of glaucoma—headaches, halo formation, cupping of the optic disk and slightly heightened tension. These cases show other signs of endocrine imbalance; in the females among whom the incidence is higher, there are disorders of menstruation. A large mass of data points to correlation of disorders of puberty and sex development and the development of myopia. Evidence at hand indicates the whole series of disorders are fundamentally in the nature of a profound alteration of the water-salt metabolism, and it leads to the belief that sex development may be basically an alteration in the water-salt metabolism or conditioned by it. The administration of cortin to these cases has effected a reduction or arrest of the myopic process and an amelioration of associated symptomatology.

EMANUEL M. JOSEPHSON

NEW YORK, N. Y.

THE NEW ACTIVE PRINCIPLE OF ERGOT

A RECENT exchange of communications between Dr. Ralph G. Smith, of the University of Michigan, and myself necessitates the correction of an error which appeared in my discussion of this subject in the issue of SCIENCE for June 28. The error has to do with the optical activity of my ergostetrine and the ergotocin of Kharasch and Legault. Instead of claiming that ergotocin (free base) is dextro-rotatory, Kharasch and Legault's claim is that ergotocin *salts* are dextro-rotatory. They did not, as I stated, give the optical activity of the free base. This removes the difference in our observations on this point, since the common salts of my ergostetrine are also dextro-rotatory and, as I stated in my discussion, ergostetrine base and ergotocin base were found to be indistinguishable in exhibiting laevo-rotatory properties. Professor G. L. Jenkins, of this university, confirmed this observation. I regret the error thus made in my discussion. Concerning optical activity and decomposition point of the

free ergostetrine base, further work shows that repeated recrystallization finally results in a snow-white product which melts and decomposes at 161 to 163 degrees C., and which is dextro-rotatory in water, alcohol and chloroform. Whether this change in properties is due to simple purification or to an actual change in the molecule is being studied, with emphasis on the relationship of these changes to pharmacological activity.

The issue of SCIENCE for June 21 contains a discussion of the new ergot principle by Kharasch and Legault, in which they state that "The question as to whether ergotocin is an alkaloid seems to us to be essentially meaningless, since there are no definite criteria by which a substance may be characterized as alkaloidal or non-alkaloidal."

From the standpoint of pharmaceutical chemists, to classify a plant or animal substance as an alkaloid is of fundamental importance, immediately identifying the substance as a relatively complex organic chemical entity containing nitrogen, whose free base is alkaline in reaction and capable of neutralizing acids to form salts, whose free base is much less soluble in water than its salts, whose free base is much more soluble in ether, chloroform, benzol, etc., than its salts, and as a substance whose salts in solution release the free base upon the addition of alkalies. Ergotinine, ergotoxine, ergotamine, ergotaminine, pseudo-ergotinine, sensibamine, ergoclavine and ergostetrine have been classified since their discovery as alkaloids and as alkaloids *only*. To state that this classification is essentially meaningless, in the face of its usage in the abundant ergot literature as well as that pertaining to other important drugs is as much as to state that all chemical classifications are meaningless and unessential.

MARVIN R. THOMPSON

SCHOOL OF PHARMACY
UNIVERSITY OF MARYLAND

SCIENTIFIC BOOKS

A SOURCE BOOK OF PHYSICS

A Source-Book in Physics. By WILLIAM FRANCIS MAGIE, Professor of Physics, Emeritus, Princeton University. McGraw-Hill Book Company, 1935. pp. xiv + 620. Price, $5.00.

THIS is an impressive volume. It leaves the past at the door of the reader. To collect and to put into English dress one hundred and sixteen of the most important contributions to physics that have appeared during the three centuries which intervene between the appearance of Gilbert's "De Magnete" and Planck's "Quantum Theory" is a service of no mean order. It would, in fact, be difficult to overestimate the value of this book for any young man who wishes to put himself *en rapport* with the best that has been said and done in the domain of experimental physics. The omission of mathematical physics—fundamental and important as that branch is—will not be serious for the undergraduate; since the absence of algebraic formulae does not mean the omission of quantitative ideas. The only person likely to forget that modern physics is an experimental science is the young student who observes an indolent lecturer covering the blackboard with equations because this is easier than to cover the lecture table with appropriate experiments.

The space available to the author was presumably determined by the fact that this volume is one of the series of "Source-Books in the History of the Sciences" of which Professor Gregory D. Walcott is the general editor. The manner in which Professor Magie has distributed his six hundred pages is instructive. The first 65 are given to "Mechanics"; the next 50 to "Properties of Matter"; then follow 30 pages covering "Sound"; and 140 devoted to "Heat"; to "Light," 122 pages; while the last 229 pages go to "Magnetism and Electricity."

Each extract is preceded by a brief but well-balanced biographical sketch of the investigator, and the essential feature of his particular contribution to knowledge is pointed out. The value of these editorial notes arises partly from the fact that many of these names are strange to young ears and partly because most of the seventeenth and eighteenth century papers are written in a scientific lingo quite different from our own. On the other hand, one can not fail to be impressed by the remarkable clarity with which the original discoverer of any phenomenon always describes his result. He goes at once directly to the heart of the matter.

Of the translations, some are borrowed and some are by Professor Magie. The man who renders a foreign language into his own is, of course, always attempting the impossible. In physics, especially, he is confronted by two snags: one is the use of a terminology which gives the impression that our ancestors were in possession of ideas which belong only to later times; the other is the use of a nomenclature which is so literal and antiquated that it ceases to be clear or to give the correct impression to the modern mind. Thus, on page 199, the question arises as to whether J. R. Mayer's *Kraft* should be rendered by *force* or *energy*. Carey Foster, in the *Philosophical Magazine,* twenty years after Mayer's publication, translates it into

force. But the essential truth, as understood by Mayer, certainly calls for *energy.* Again, for example, in the great paper of Helmholtz on the "Conservation of Energy," Professor Magie's own translation would be preferable to that of John Tyndall who, though thoroughly *au courant* with the best physics of his day, was nevertheless using the imperfect nomenclature of 1853. Thus (p. 219) when Helmholtz proceeds to quantify Faraday's discovery of 1831, the first sentence of the translation is "when a magnet moves under the influence of a current, the *vis viva* gained thereby must be furnished by the tensions consumed in the current." Here *vis viva* is Tyndall's rendering of *lebendige Kraft,* a translation which leaves the English reader in doubt as to the factor "1/2": "kinetic energy" would have certainly carried the "1/2" with it. In the phrase "tensions consumed in the current," Helmholtz could scarcely have had in mind anything but what we call "E. M. F. drop." A correct translation depends partly upon the words of the writer, partly upon the vocabulary of the reader, and is therefore a function of time. Owing to rapid changes in scientific nomenclature, a translation which fits one generation may be quite inapt for the next.

A fine perspective is displayed by the author in bringing closely related papers into immediate juxtaposition and in his allotment of space to individual investigators. Ten pages is none too much for Black's account of the phenomena which lead up to the ideas of *specific heat* and *latent heat,* a masterpiece of scientific description. Thirteen well-deserved pages are assigned to Ampère's fundamental work. Seven pages, devoted to the law formulated by Ohm, show us how far he was from our present conception of that law—the one which Weber and Kirchhoff gave us—and yet how skilfully he treated his data and how clearly he expressed his imperfectly understood results in terms of two numerical constants *a* and *b*.

In these days, when research has become a powerful educational instrument, one might expect a disregard for earlier work and a lack of respect for the past; but the reverse of this appears to be the fact. As one bit of evidence, compare the prices to-day with those of fifty years ago when it comes to acquiring some of the "sources" which are reproduced in this volume.

A few trifling inadvertencies which ought to be considered before a new edition is issued are the following: In the first sentence in the book, Professor Magie has many excellent authorities, such as the Ninth Edition of the Encyclopedia Britannica (corrected in the eleventh), for saying that Galileo was born on the 18th of February. The late Professor Antonio Favaro has, however, established the fact that Galileo was born on the 15th of February and that citizens of Pisa were so anxious "to make the dying of Michelangelo coincide with the borning of Galileo" that they deliberately added three days to this latter date and accordingly engraved the "18th of February" on the marble slab which marks the house where the great Italian is "supposed" to have been born.

On page 398, six years should be added to the date given for du Fay's birth; and in the first line of page 447, ten years should be subtracted from the date given for Ampère's most celebrated paper. A slip of the pen has substituted *Padua* for Pavia in the third line of the biographical sketch of Volta on page 427.

The controlling idea of this volume is identical with that of "Harper's Scientific Memoirs," edited by Professor Joseph S. Ames a generation ago; but here the number of papers reported is much larger and the unimportant details are omitted; nevertheless, the book is one which historians would describe as "abundantly documentated." The collection is one upon which the verdict of scholars has already been passed. For the student who wishes to build upon "the solid ground of nature," its significance is no longer open to question.

HENRY CREW

X-RAYS

X-Rays in Theory and Experiment. By ARTHUR H. COMPTON and SAMUEL K. ALLISON. D. Van Nostrand Company, 1935. vii + 828 pp. $7.50.

X-RAYS in medicine, in crystallography and in engineering are all dependent on x-rays in theory and experiment, and it is in theory and experiment that Compton and Allison have made their great contributions. A book by them devoting all its 835 pages to this field, as indicated by its well-chosen title, is therefore most welcome.

Originally this book was going to be a second edition of Compton's "X-Rays and Electrons," which appeared in 1926, but the rapid progress of x-ray research since that date made it practically a new book. On the theoretical side the greatest changes were of course those due to the new quantum mechanics, while the experimental side was changed partly by the advent of new theoretical predictions to be tested, but at least as much by improvements in technique. Old experimental apparatus, such as Wilson's fog tracks and Robinson's magnetic velocity spectra, were improved and turned to new uses, and among new types of apparatus were Ross's differential filters for spectrum analysis, double-crystal spectrometers, thin targets and x-ray diffraction gratings.

To be sure, even with all these influences for growth, the changes in the science of x-rays in this decade, its fourth, were not nearly so revolutionary as those in its first decade or even in its second; and there is a

disconcerting air of finality in the regularity with which the present book records agreements between the new experimental data and the new wave-mechanical theories. This, however, is not the fault of the book nor a peculiarity of x-rays as distinguished from other branches of the physics of electrons. The question whether we now know all that is very exciting about electrons may or may not be worth discussing elsewhere. Here the outstanding fact is that x-rays have been one of the most fruitful sources of evidence about electrons, not only in earlier decades but also in this last, and they probably have plenty more to tell us.

The authors' main objective, however, is not the ephemeral one of outlining the next research problems to be studied. Rather, as stated in their preface, "the main objective of "X-rays in Theory and Experiment" is to present a comprehensive view of the whole field, to call attention to those aspects which seem of most fundamental physical significance, and especially to discuss the theory of the phenomena in sufficient detail that their meaning can be appreciated." And very wisely, they do not go into all this detail at first. Instead, they make their first chapter an excellent preliminary of the whole field. Then for six chapters they go into details in a sort of life-history order, starting with the production of x-rays and following them through scattering, refraction and reflection to their photoelectric absorption. Finally there are two chapters on the interpretation of x-ray spectra and recent refinements in accuracy of measurements, and some mathematical appendices.

Throughout the book, the style is clear and logical. In the first chapter, the survey, the authors use practically no calculus, but they need none, because their objective there is simply to introduce the student to unfamiliar phenomena by qualitative descriptions. This chapter can be read with interest and understanding by any student who has done well enough in first-year physics to want more. From there on, however, free use is made of calculus, but only of such parts of it as a good student acquires in his first year in that subject; and the authors show remarkable consistency in subjecting the student to this much calculus on the slightest provocation but never letting themselves be tempted to overstep this limit.

Necessarily, this restricts the discussion of wave-mechanical theories very seriously. In many cases the less mathematically inclined students might get the impression that wave mechanics is like pulling rabbits out of a hat, and they might fail to appreciate the existence of wave functions that can be visualized and used for qualitative understanding of the theory and for intuitive thinking about what effects to look for next. But this will not happen to students who really want to learn. The fundamental principles of wave mechanics are stated and discussed early in the book, in connection with the production of x-rays, so the better students can see there that the next thing they need is more mathematical study and that the rewards for such study are great. Likewise in discussing the Compton effect (which by the way, the authors modestly call by other names), it is clearly proved that wave mechanics handles the free-electron case very simply and that for any quantitative explanation of scattering by bound electrons wave mechanics is absolutely essential. So even if it seems later to play the rôle of deus ex machina in decreeing queer absolute values for the angular momenta in atoms emitting spectral lines, the students who have the ability to learn more mathematics will be in no danger of lapsing into contentment with vector-model theories. No matter how strongly a reader may want wave mechanics to be carried further, therefore, he probably must admit that the place for that is in books primarily on wave mechanics rather than on x-rays, even as restricted to their place in theory and experiment, and that the choice of material in the theoretical discussions here is really excellent.

DAVID L. WEBSTER

STANFORD UNIVERSITY

SPECIAL ARTICLES

CONCANAVALIN A AND HEMAGGLUTINATION[1]

HAVING identified the substance in the jack-bean which agglutinates the red cells of certain animal species as the crystallizable globulin, concanavalin A,[2] we have attempted to explain the mechanism by which hemagglutination is brought about.

It has been found that neutral suspensions of higher fatty acids and of coconut, linseed, olive, almond and jack-bean oils are agglutinated by adding concanavalin A dissolved in salt solution. It therefore appeared possible that the lipids in the surface layers of erythrocytes might be similarly affected. However, suspensions of butter, castor oil, lecithin and cholesterol acetate are not agglutinated by concanavalin A and suspensions of lipids extracted from erythrocytes are only incompletely agglutinated.

We have observed that suspensions of rice starch,

[1] From the Department of Physiology and Biochemistry, Medical College, and the Department of Veterinary Bacteriology, Cornell University, Ithaca.

[2] J. B. Sumner and S. F. Howell, *Jour. Immunology*, in press.

corn starch and baker's yeast are readily agglutinated by A and that boiled starch is precipitated by A. Glycogen is very completely precipitated at neutrality. As little as 0.01 mg of glycogen in 5 cc of solution eventually forms a perceptible haziness after adding a few mg of concanavalin A. At first it appeared likely that the agglutination of erythrocytes might be due to a reaction between concanavalin A and the glycogen present. Cow erythrocytes are not agglutinated by A, but after adding traces of glycogen, A agglutinates them readily. However, agglutinatable red cells, such as those of the horse, dog and cat, appear to contain too little glycogen to permit this hypothesis to be accepted. Furthermore, the agglutination of such cells is not prevented by previous incubation with salivary or pancreatic amylase, as would be expected if glycogen were the substance reacting.

We have found that the erythrocytes of the horse, dog and cat, after laking, give a fairly heavy precipitate with concanavalin A, whilst laked cow, goat, sheep and human erythrocytes, which are not agglutinatable, or which are agglutinated with difficulty by A, give no such precipitate. Evidently the erythrocytes which agglutinate do so because of the production of this precipitate. We have not yet succeeded in isolating the substance which forms the precipitate. It is thermolabile and appears to be a protein, but is not hemoglobin.

Joos[3] has claimed that the agglutination of bacteria by immune serum is dependent upon the production of a chemical compound, and we believe that the agglutination of erythrocytes is caused by the formation of an insoluble compound composed of the unknown substance, or substances, and concanavalin A. The unknown substance can not be said to exist in the dissolved state; nevertheless we consider it to be an hydrophyllic colloid. Upon addition of concanavalin A, chemical combination occurs and a hydrophobic compound is formed. This hydrophobic compound offers no impediment to agglutination if salt is present. The red cells of the cow do not contain a substance capable of combining with concanavalin A, but are assumed to contain a hydrophyllic colloid which prevents spontaneous agglutination. When glycogen is added to cow cells, it is adsorbed upon their surfaces and subsequent addition of A forms a hydrophobic compound. If amylase is added to cow cells thus agglutinated, the glycogen is rapidly digested and the cells can be partly resuspended by shaking.

The most difficult point requiring explanation is why hydrophyllic substances present in the surfaces of erythrocytes prevent spontaneous agglutination. We assume that such hydrophyllic compounds attract films of water which act as envelopes and thereby prevent neighboring cells from making contact.

We wish to express our appreciation to the Sackett Fund Committee for financial assistance in this research.

JAMES B. SUMNER
STACEY F. HOWELL
ALEXANDER ZEISSIG

[3] A. Joos, *Zeit. für Hygiene*, 36: 422, 1901.

CHANGES IN THE POSITION OF CHICK EMBRYOS AFTER THE EIGHTEENTH DAY OF INCUBATION[1]

IT has been demonstrated repeatedly that many chick embryos dying on the eighteenth day of incubation or later, and examined generally on the twenty-second day, are not in the normal position for hatching. New evidence indicates that there is a decided change in the position of the chick embryo after the eighteenth day of incubation and that certain of the previously designated malpositions found in chick embryos are but a natural occurrence in normal development.

Extensive studies have been made by various investigators on the frequency of these so-called embryonic malpositions in the egg of the domestic fowl. In general embryos dying on or after the eighteenth day of incubation have been grouped together, according to their respective positions. Such a classification assumes that no profound change would take place in the position of the embryo after the eighteenth day of incubation. That such is not a correct assumption will be pointed out in this study.

The eggs examined in the present investigation were from a group of inbred single comb White Leghorns with an inbreeding coefficient ranging from 25 to 78 per cent., non-inbred White Leghorns and from a White Leghorn and Light Brahma cross. A total of 1,011 live embryos were available for examination. The eggs were divided into two lots and incubated at two different periods. The seven positions studied were classified as follows: I, normal hatching position; II, head between thighs; III, head in small end of egg; IV, head turned to left; V, normal but beak away from air cell; VI, feet over head, and VII, normal but head above the wing.

In the first phase of this study 51 live embryos were examined on the nineteenth day of incubation and only 7.8 per cent. of these were in the normal hatching position. More were in position VII, which is normal, except that the head is above the wing instead of under it. Fifty per cent. of the embryos were in either position II, III or IV. On the twentieth day of incubation 50.1 per cent. were in the normal hatching position, while 32.9 per cent. were in position VII. Only 16.1

[1] Journal Paper No. J-192 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project No. 54.

per cent. were in either position II, III or IV. A X^2 test for significance shows that the difference in the results, including all positions between the nineteenth and the twentieth day of incubation, is highly significant. It is evident that there is a decided shifting of embryonic position after the nineteenth day of incubation.

An examination of all embryos dying after the eighteenth day of incubation and examined on the twenty-second day of incubation shows that most of the so-called embryonic malpositions occur from the eighteenth to the twentieth day of incubation, with the exception of position VII. None of the dead embryos in this group were in the normal hatching position until the twentieth day of incubation. Also few of the embryos were in malpositions on the twenty-first day of incubation.

The data of the second phase of this study substantiate the examinations made in the first phase. There is a very decided change in embryonic position from the eighteenth to the twentieth day of incubation. An examination of 117 live embryos on the eighteenth day of incubation failed to show any individuals which could be classified in the normal hatching position. An examination of 100 live embryos on the nineteenth day showed 25 embryos in the normal hatching position. Thus there is a very decided increase of embryos found in the normal hatching position on the nineteenth day of incubation and a corresponding decrease in the number of embryos found in the so-called malpositions. On the twentieth day there is a marked change in embryonic position from that found on the eighteenth and nineteenth days, for 76 live embryos out of 103 examined were in the normal hatching position.

The results obtained from these embryonic examinations present a new problem on the concept of embryonic malpositions. Previous available evidence would indicate that embryonic malpositions are the immediate cause of death of the embryo, particularly after the eighteenth day of incubation. It is a well-known fact that embryonic mortality is generally the highest during the eighteenth and nineteenth day of incubation. Seemingly, then, malpositions might be one of the reasons for this high eighteenth and nineteenth day embryonic mortality. If, however, malpositions cause the death of the embryo very few of the eggs used in this study would have hatched. The position most prevalent on the eighteenth and nineteenth day of incubation is that of the head between the thighs, which has been designated as position II in this study. It is obvious that if the embryo persists in this position up to the twenty-first day the egg can not hatch.

The evidence presented is conclusive that embryonic changes take place within the egg after the eighteenth day of incubation and that certain of the so-called malpositions are but a natural occurrence in the normal development of the chick embryo. If embryonic death occurs during the approximate eighteenth day period the embryo will probably not be in the normal hatching position. It is very probable that certain of the previously designated embryonic malpositions are not necessarily lethal, but that death is caused by some other agency and the embryo is in its normal position for its particular stage of development.

NELSON F. WATERS
IOWA AGRICULTURAL EXPERIMENT STATION

MATERNAL BEHAVIOR IN MALE RATS[1]

MATERNAL behavior has recently been described[2] in *virgin* rats and attributed to the lactogenic hormone of the anterior pituitary. This paper proposes to show that maternal behavior can be induced experimentally in *male* rats and that this can occur in the absence of mammary development.

Chronic administration of bovine anterior pituitary implants (Table I), or complete thyroidectomy without treatment (Table II), induced adult male rats to

TABLE I

EFFECT OF CHRONIC ADMINISTRATION (60 DAYS) OF BOVINE ANTERIOR PITUITARY IMPLANTS ON ADULT MALE RATS (5 MOS. OLD)

No. rats	No. implants	Total mg tissue implanted	Weight in mg				Maternal behavior
			Hyp.	2 Adr.	2 Thyr.	2 Testes	
10	14	7,100	14	103	36	2,825	Yes
10*	.....	.....	9	36	43	3,171	No

* Controls.

behave differently from their normal brothers and virgin sisters, as evidenced by the following actions: (1) making a nest for young rats put in their cages, and lying over them for hours[3]; (2) nest-building and nesting even in absence of young; (3) settling down

[1] From a dissertation submitted in partial fulfilment for the degree of doctor of philosophy in anatomy, University of California.

[2] B. P. Wiesner and N. M. Sheard, "Maternal Behaviour in the Rat," London, 1933. O. Riddle, E. L. Lahr and R. W. Bates, *Proc. Soc. Exp. Biol. Med.*, 32: 730, 1935.

[3] The young suck the skin and hairs of the abdomen, and are permitted to hang on the hairs when the foster parent arises.

TABLE II
EFFECT OF THYROIDECTOMY ON MALE RATS (3½ MOS. OLD) OPERATED ON AT THE AGE OF 1 MONTH

No. rats	Body wt. (gm)	Weight in mg				Maternal behavior
		Ant. Hyp.	2 Adr.	2 Thyr.	2 Testes	
20	215	13	36	.....	2,965	Yes
20*	290	6	37	41	2,989	No

* Controls.

for long periods on a pile of newborn rats in a can placed on a table; (4) picking up the newborn rats and licking them in a maternal way; (5) desire to doze and snuggle in corners or up against objects, if given the freedom of a large shelf in the laboratory; (6) tendency to huddle in small groups, at intervals licking each other affectionately, when allowed to roam at will on the floor.

In both groups, the pituitaries were considerably enlarged, compared with those of the male controls. No mammary development was observed in the thyroidectomized males.

MORVYTH MCQUEEN-WILLIAMS
UNIVERSITY OF CALIFORNIA
BERKELEY

EGG QUANTITY AND THE RESPIRATORY RATES OF SEVERAL MARINE EGGS

IN previous publications[1] the rates of oxygen consumption by the eggs of *Fucus, Cumingia, Nereis, Chaetopterus* and *Arbacia* were expressed in mm^3O_2 per hour per 10 mm^3 eggs. The quantity of eggs was determined in volume units by centrifuging to approximate equilibrium packing of the eggs in calibrated vaccine tubes having diameters of the order of 2 mm. As the eggs distort to pack tightly under strong centrifugal force, the measured volumes were regarded as only slightly too great, due to interstitial space among the eggs. The centrifugal force used was not reported.

More recently, in the case of *Arbacia,* Gerard and Rubinstein[2] have compared volume determination by centrifuging, and by haemocytometer counts and dilution counts with measurements of egg size. They have found centrifuge determinations to average 80 per cent. or more too great. This was with relatively low centrifugal force, 400–750 × gravity. Shapiro[3] has compared the equilibrium centrifuge volume of *Arbacia* eggs at various centrifugal forces with the volume determined by haemocytometer and dilution counts. He finds that at 2700 × g centrifuge volumes agree with determinations by haemocytometer counts to within an average of approximately ± 10 per cent. Fifteen determinations showed an average greater volume by centrifuging of 12 per cent., while fourteen showed an average lesser volume of 7.7 per cent.

Since the magnitude of the error of volume determination by centrifuging depends on the centrifugal force (being greater at low force), the particular centrifugal forces used in deriving the respiratory rates referred to above should be reported. When conversion factors have been established for the several eggs the rates may then be converted to absolute volume units. Late in the summer of 1934, with the kind assistance of Dr. Samuel Pond, the same (unaltered) centrifuge previously used at the Marine Biological Laboratory for the eggs referred to (except *Fucus*) was accurately calibrated under conditions previously used. The centrifugal force was 2850 × g, or if an allowance of 10 per cent. speed retardation during calibration is made, it may have been as high as 3400 × g. The duration of the original centrifuging in the cases of *Cumingia, Nereis* and *Chaetopterus* was 15 minutes. *Arbacia* eggs were centrifuged in some cases 15, in some 10 and in some 18 minutes. *Fucus* eggs were centrifuged 15 minutes or longer at lower centrifugal force, probably of the order of 1500 × g.

This does not affect relative rates previously given for the same eggs measured before and after fertilization. Comparisons[4] of absolute rates of different species of eggs (or of the same species when volumes are measured by different methods) are untenable,[5] except upon the assumption that the errors of volume determination are small (or are similar[5]).

D. M. WHITAKER
STANFORD UNIVERSITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

STROBOSCOPIC OBSERVATION OF CILIARY MOVEMENT IN THE PROTOZOA

STROBOSCOPIC observation is carried out by means of light interrupted into consecutive flashes of known frequency and duration. In the study of normally beating cilia under a microscope supplied with stroboscopic light it is possible by varying the flash frequency to obtain the effect of slowing the cilia to any

[1] *Jour. Gen. Physiol.,* 15: 167–200, 1931; and 16: 475, 1933.
[2] *Ibid.,* 17: 375, 1934.
[3] *Biol. Bull.,* in press.
[4] *Jour. Gen. Physiol.,* 16: 497, 1933.
[5] J. Runnström, *Protoplasma,* 20: 1, 1933.

speed desired or of arriving at complete standstill. If the number of ciliary beats per second be represented by x, then the effect of motionless cilia will be obtained at a flash frequency of x or multiples of x, and also at $\frac{1}{2}\ x$, $\frac{1}{4}\ x$, and on down to the limits of visual perception. The individual cilium will be seen at more than one position at "harmonics" above x, thus making it possible by varying the frequency to determine the true speed of ciliary beat. After x has been roughly determined the higher harmonics may be used to reduce eyestrain and cut down the probable error. Consistent practice will overcome the subjective difficulties involved.[1]

Although the stroboscopic method gives far more accurate results than narcosis or other common techniques for studying ciliary movement it has been rarely used and then usually through the medium of the motion picture camera. The cost of film makes the photographic method impracticable for extended observations.

Very satisfactory stroboscopic effects were obtained by the writer by interrupting the focused rays of a projection lamp at their point of convergence by means of a rotating 9″ bakelite disk bearing two $\frac{3}{8}$″ holes one inch from the periphery and at opposite sides of the disk. This arrangement gives two flashes per revolution at a time relation of 5 per cent. light to 95 per cent. darkness. At a ciliary frequency of, say, 20 cycles per second the duration of each flash is but .0025 seconds, which amply satisfies the optical requirements concerned. The disk is mounted on a shaft of a small electric motor controlled by a variable resistance. The speed is ascertained by a polygraph mechanically connected to an eccentric on the shaft. Either dark-ground or conventional condenser may be used and the usual magnifications employed.

Preliminary studies have been made on *Vorticella microstoma, Paramecium caudatum, Epistylis* sp., and *Stentor coeruleus*. Temperature was not under strict control in this introductory work, varying with the room from 20° to 24° C.

The *Vorticella* studied showed ciliary frequencies of from 6 to 8 cycles per second.

P. caudatum was studied in groups accumulated in debris in an old culture. Three zones of cilia were found: (1) the "body" cilia; (2) the longer cilia of the oral groove, which were seen to begin at a point just aboral to the anterior tip of the animal, coming up around the tip and progressing posteriorly in a narrow triangular area with its base at the cytostome; (3) the cilia of the gullet. The zones were differentiated by their differences in speed and nature of beat. Because of the movements of the animals it has been possible to date to measure accurately the frequency of the cilia in group 2 only, a value of 8 cycles per second being found. Studies of these cilia in six *Paramecium* in one group revealed a variation of less than 0.1 cycles per second.

The average of several individuals in two colonies of *Epistylis* gave: colony A, 12 and colony B, 11 cycles per second. A pair of animals in colony *A*, which from their position on the stalk were daughters of a recent division, showed consistent frequencies of 48 for y and 50 for z at the $4x$ harmonic. This is an absolute frequency of 12 and 12.5, respectively.

The "body" cilia of *Stentor* were found to be more or less irregular in action, so the membranelle series was used for this study. Individuals from a flourishing culture showed a range of frequencies of 32 to 42 cycles per second; those from an old run-down culture were very consistent at 26 per second. Preparations sealed against evaporation dropped off as much as half in speed in twelve hours. The pH and oxygen supply are under investigation. The metachronal wave covers seven membranelles, five of which are in recovery, two in effective stroke. The effective stroke ends in a vertical position, while in recovery the membranelles do not bend back in the same plane, but out and down over the edge of the animal until at the end of recovery they are twisted nearly 180° away from their position at the beginning. This results in the effective stroke in a lash directed upward and inward. The twisting reaction in *Stentor* resulting in the detachment of the foot is due to a lengthening of the effective stroke of the membranelles to about 25° past the vertical, the frequency remaining unchanged. Once the animal is freed and swimming ahead the character of the beat returns to normal, the frequency still unchanged.

Interesting fields of investigation are suggested by these results obtained by the stroboscope. The forms studied from run-down cultures showed the least variation in frequency of ciliary beat. The variations found in forms from flourishing cultures may be correlated in some way with division, thus suggesting a new approach to the problem of the relation of division to vitality. Stroboscopic observations are important in the question of coordination in ciliates, *e.g.*, none of the so-called coordinating fibrillar systems so far described in *Paramecium* will explain the three different zones of ciliary activity in that animal. Further, the determination of the frequency of beat and the length of the metachronal wave makes it possible for the first time to calculate the speed of the coordinating impulse in Protozoa. In *Stentor*, the only form in which accurate measurements of the metachronal wave have been made to date, the value of 30 microns was obtained. This, multiplied by the highest frequency obtained, gives a maximum value of only 1.2 mm per

[1] Gray, *Proc. Roy. Soc. London*, B 107: 313, 1930.

second. The other ciliates studied obviously have a much lower speed of coordinating impulse. These values are so far below the velocities of true neural impulses that it is not possible to consider a "neuromotor" factor in the coordination of these Protozoa.

Further investigations are in progress along the lines indicated here and will be reported in detail.

The writer is indebted to Dr. W. M. Barrows for suggesting the use of the stroboscope in the study of the Protozoa.

J. C. HAMMOND

OHIO STATE UNIVERSITY

DARKFIELD MICROMANIPULATION WITH AN ULTROPAQUE ILLUMINATOR

RECENTLY I had been studying the surface precipitation reaction[1] in the ameba. The experimental work consisted in tearing *Amoeba proteus* and *A. dubia* with a microneedle in various salts solutions. This technique is essentially similar to that used by Chambers and Reznikoff.[2] If an ameba is carefully torn in a solution containing an appropriate concentration of Ca- or Sr-ions, a new plasmalemma will be formed at the zone of tearing. Before the new plasmalemma is formed, some of the protoplasm will exude into the surrounding medium in the form of granules, crystals and unorganized matter. This more or less rapid disintegration of protoplasm will continue until the new plasmalemma is formed. The time at which this new plasmalemma is produced may be more easily determined if the ameba is studied under darkfield illumination.

Although special darkfield condensers are available for micrurgical technique, their use is somewhat limited. A specially designed moist chamber is needed. The regular substage condenser must be removed before the darkfield condenser can be installed. Brightfield illumination as furnished by the substage condenser is indispensable for making preliminary adjustments of the microneedles. In order to use both brightfield and darkfield illumination it is necessary to interchange these condensers. This procedure complicates the micrurgical technique and frequently the original adjustments of the microneedles are disturbed.

An ideal arrangement should furnish either brightfield or darkfield illumination without involving an interchange of condensers. Also this arrangement should permit the use of any style or height of moist chamber. The Ultropaque illuminator[3] adequately fulfils these requirements.

This instrument is a vertical illuminator permitting the use of a large series of objectives. The light source, consisting of a low voltage Mignon lamp, is an integral part. Color, neutral or heat-resisting filters may be conveniently used. The entire unit is mounted on the microscope in place of the revolving nosepiece. The substage condenser need not be removed. Each objective is furnished with a ring condenser. A slight rotation of this condenser will produce varying degrees of illumination ranging from brightfield to darkfield without disturbing those adjustments previously made either with the microscope or with the micromanipulator.

I use the following procedure. The amebas are mounted in a shallow hanging drop on a coverslip which is then placed on the moist chamber. The ring condenser is adjusted to give darkfield illumination. The preliminary adjustments of the microneedles are made in a brightfield furnished by the substage lamp and condenser. Two toggle switches conveniently placed near the micromanipulator are used to control the two sources of light. At any time, during or after the ameba is torn, the substage lamp may be quickly turned off and the Ultropaque turned on. Thus the effect produced by the microneedles on the protoplasm may be immediately studied with an excellent darkfield illumination.

Some of the intermediate degrees of illumination are exceedingly useful. In a semi-darkfield the *plasmalemma/medium* interface may be seen very distinctly. A semi-brightfield is useful in studying the nucleus; while the minute granules within the ectoplasm may be made visible if extreme darkfield is used. In transmitted light these ectoplasmic granules are not evident. Thus any change in the size, aggregation or number of granules can be readily detected. In a darkfield the tips of the microneedles when in focus appear as very bright luminous points.

The use of darkfield illumination makes possible a closer check on the condition of the cytoplasm. The importance of being able to detect various changes in the cytoplasm (Brownian movement, streaming, etc.) while micrurgical experiments are being conducted has also been pointed out by Plowe.[4]

M. J. KOPAC

NEW YORK UNIVERSITY

[1] L. V. Heilbrunn, *Arch. f. exp. Zellf.*, 4: 246, 1927.
[2] *Jour. Gen. Physiol.*, 8: 369, 1926.
[3] Made by E. Leitz.
[4] *Protoplasma*, 12: 196, 1931.

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